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Morning and Evening Forecast Verification Comparison

At the North Central River Forecast Center (NCRFC) we have several years of river forecasts archived and available for analysis. One analysis of interest concerns evening forecast updates which are done everyday on the Mississippi and Illinois Rivers. In generating daily morning and evening forecasts there is some question as to whether the evening updates are providing value. In order to determine whether value is being added by issuing daily evening forecasts a verification analysis was done for several points on the Illinois and Mississippi river. The objective of this verification analysis is to compare the morning forecast to the evening forecast and provide statistics highlighting the mean absolute error when compared to the actual observations.

Verification Methodology:

The creation of river forecast data comparison statistics and graphs is a multi-step process starting from an archive database and ending with running an excel macro that produces the statistics and graphs. The following methodology explains this process in detail.

River forecast data is archived in the NCRFC Archive database. In order to make this data available for verification analysis the observed and forecast data must be paired using the Interactive Verification Program (IVP). IVP is run for a specific forecast segment for any available time frame to create the observed and forecast data pairing. A detailed explanation of the river forecast data archive process and IVP is beyond the scope of this paper but is available in the following reference (National Weather Service, 2001)

After the data pairs are created the data is accessed from the database by using a particular SQL command and dumped into a text file. The SQL command puts the data into a comparable morning vs. evening forecast format with the appropriate time stamp and the corresponding actual observed value. A script filters out slashes, shelf identification codes, and unnecessary time stamps to create a data format that can be transferred from AWIPS. The data are then available to be put in an EXCEL spreadsheet and a verification macro is run to create the statistics.

The verification macro is Visual Basic for Applications (VBA) code specifically made for this verification analysis. The verification macro calculates the mean absolute error in tenths of feet for the morning and evening forecast compared to the observed values for any specified time frame. A comparison of forecast data may be for an event, season, or whatever time frame might be useful. The graphs show the morning (AM) and the evening forecast (PM) together in order to compare each forecast time step (6 hours) error. Absolute error was chosen so as not to have the high and the low error values

cancel each other out. The mean error for each time step was chosen to allow for an easier visualization of forecast error trends with time and specifically to compare the AM and PM forecast error trends. For a 5 day forecast there would be 20 time steps (4 time steps per day for 5 days). The year 2004, January-May was chosen as a time of comparison for several verification points because these data were available for most of the points of interest. These verification points are mainstem points along the Mississippi and Illinois Rivers for which NCRFC issues daily morning and evening forecasts. Also, for the Mississippi at Chester a comparison was made for the same months but for 3 different years, 2002-2004. The former comparison provides a more spatial analysis while the later allows for a temporal analysis.

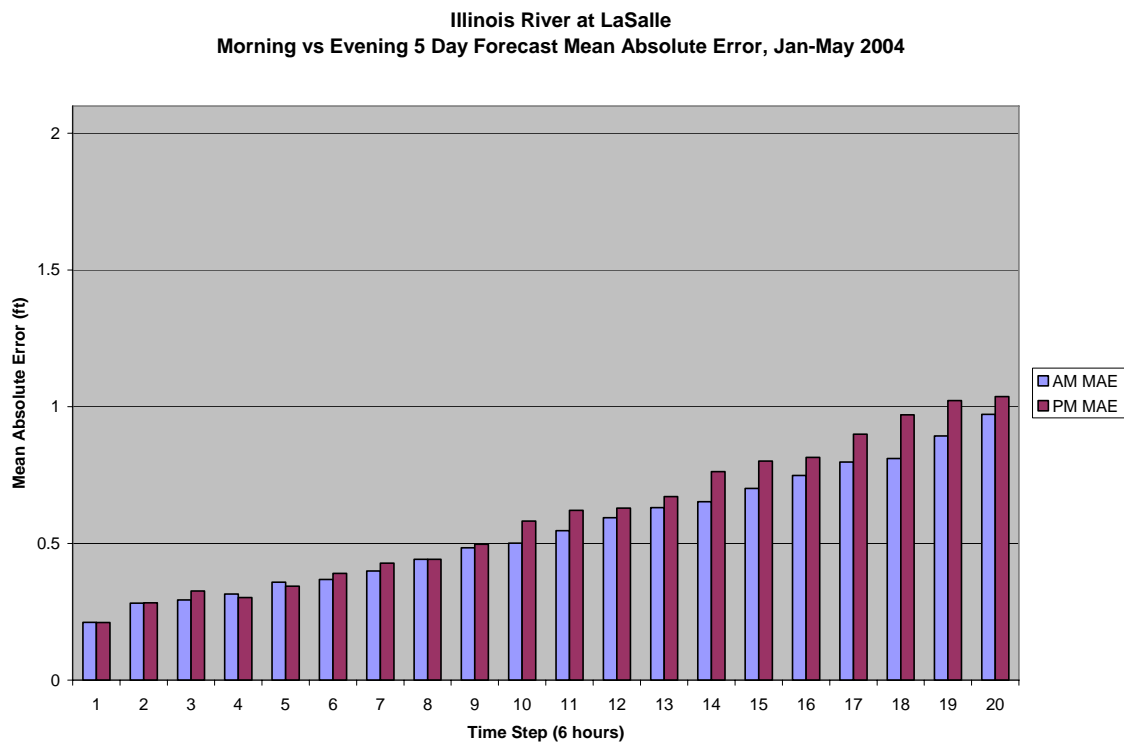
Verification Results:

The results of this forecast verification analysis are consistent spatially for these verification points and temporally for the Mississippi at Chester. The following graphs show that in the case of the Illinois River at LaSalle, Peoria, and Beardstown, there is no improvement per 6 hours time step for the 5 day evening forecast. At LaSalle the evening forecast actually shows increasing error with time. Similarly, The Mississippi graphs for Hannibal and Rock Island show no discernable improvement in the evening forecast. Further down the Mississippi at Alton, St. Louis, and Chester, there is a clear indication of a higher mean absolute error in the evening 5 day forecast. This is also true of Chester for the years 2002-2004.

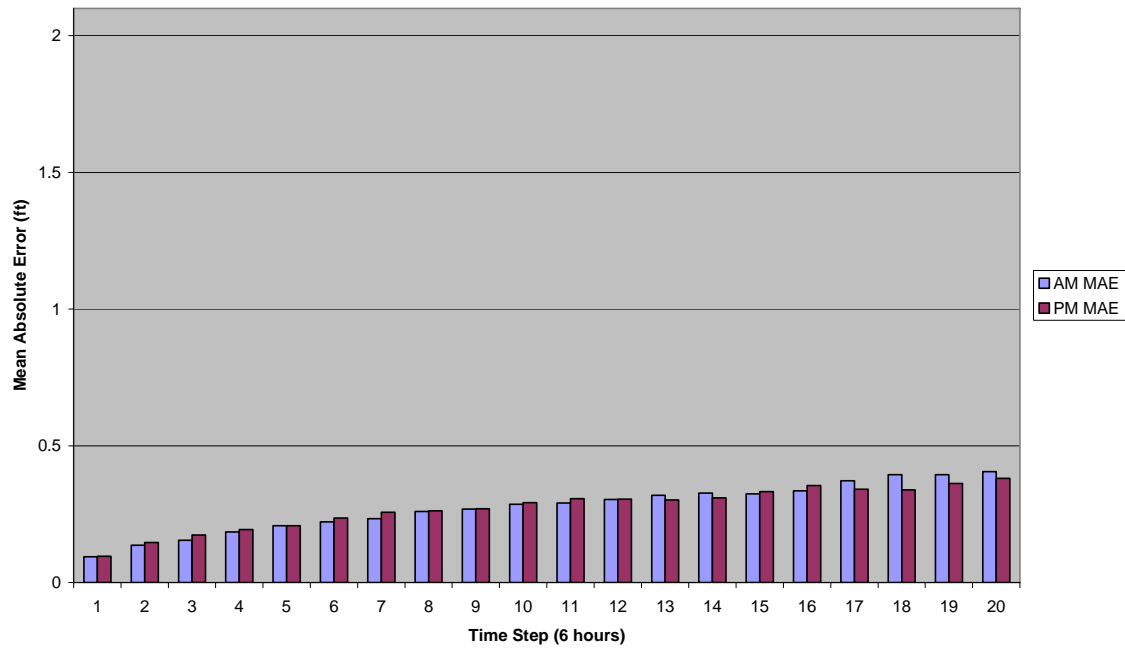
Verification Conclusion:

The AM vs PM forecast verification is complicated by the fact that the Corps of Engineers is required to keep a 9 ft channel for the Mississippi River from St. Anthony Falls, Minnesota to St. Louis, Missouri. Several of the verification gages are located just upstream of a lock and dam pool. This creates a forecasting challenge for NCRFC staff since a lock master may open or close a dam's gate settings at a moments notice in order to maintain the 9 ft channel. A verification analysis during a period of flooding would not pose the same complication since run of the river conditions apply and no regulation is needed. However, for this analysis the time frame coincided with lower than normal winter/spring flow conditions. This means regulation is a critical factor effecting daily forecasts. Verification points such as Hannibal and Peoria will typical show little forecast error or a comparable morning and evening difference due to the forecaster's knowledge that the upper pool is maintained within a certain range during regulation. Other points are tailwater affected such as LaSalle and Alton where regulation changes throughout the day can produce a great deal of error in either the morning or evening forecast. Alton, St. Louis, and Chester are complicated by the junction of several major river systems where multiple levels of regulation are partially responsible for the much greater error seen in these areas as compared to the other verification points. In fact according to a verification analysis by Dick Felch (Felch 2005) it was found that a strong correlation exists between forecast error at St. Louis and forecast error in the contributing flow of the Missouri River at Hermann. However, this correlation is regarding morning forecasts and would not explain why the evening forecasts have a higher MAE. The evening forecasts may

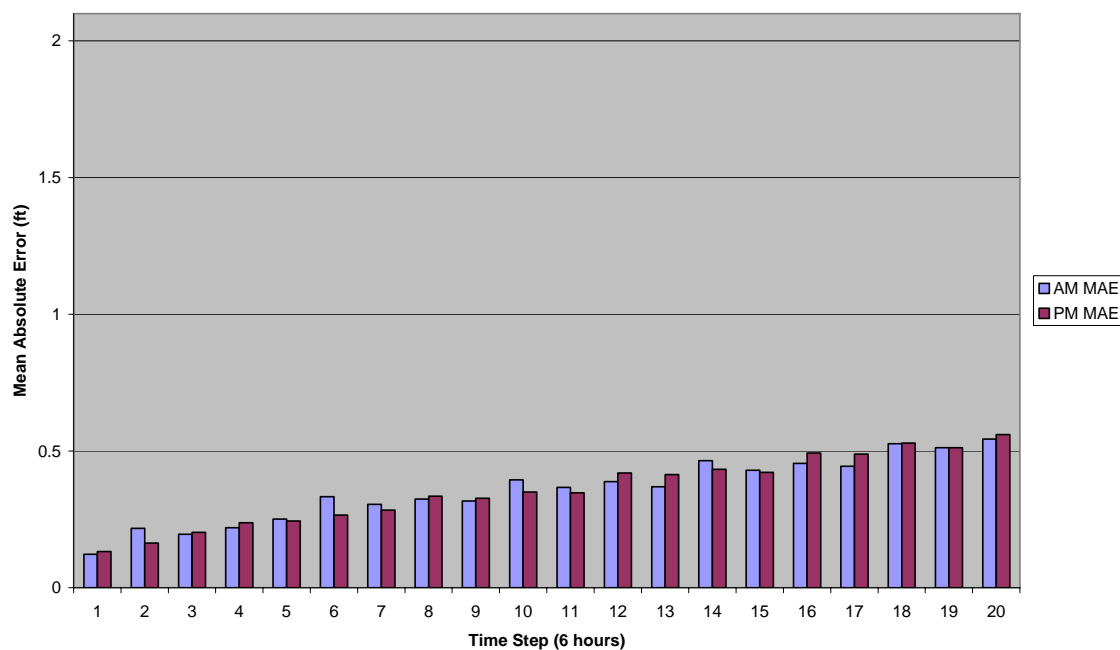
have more error due to the less extensive precipitation reports in the evening. Additionally, the Missouri inflows are updated more frequently by MBRFC in the morning than the evening suggesting a more rigorous analysis of the contributing inflows. While the source of the error is a speculation of many facets the end results show according to this analysis that the evening forecast is not providing additional value for main stem forecasts during the winter and spring of 2004 nor for 2002-2004 for the Mississippi at Chester. Additional verification analysis for rivers during flooding events may also help determine the benefits of an evening forecast.



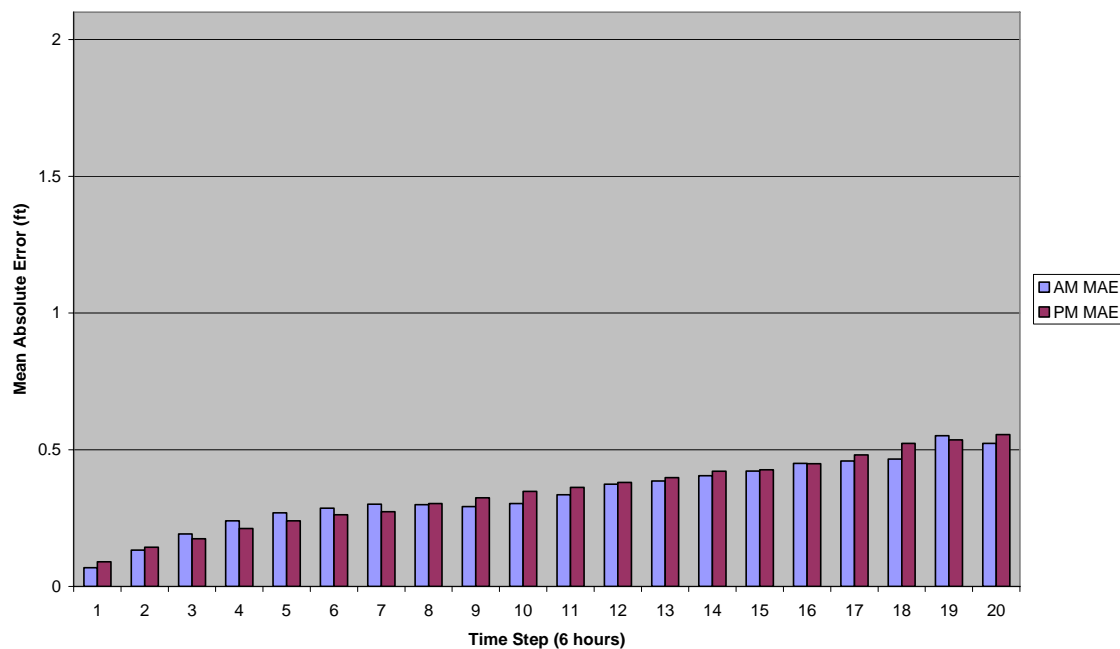
Illinois River at Peoria
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2004



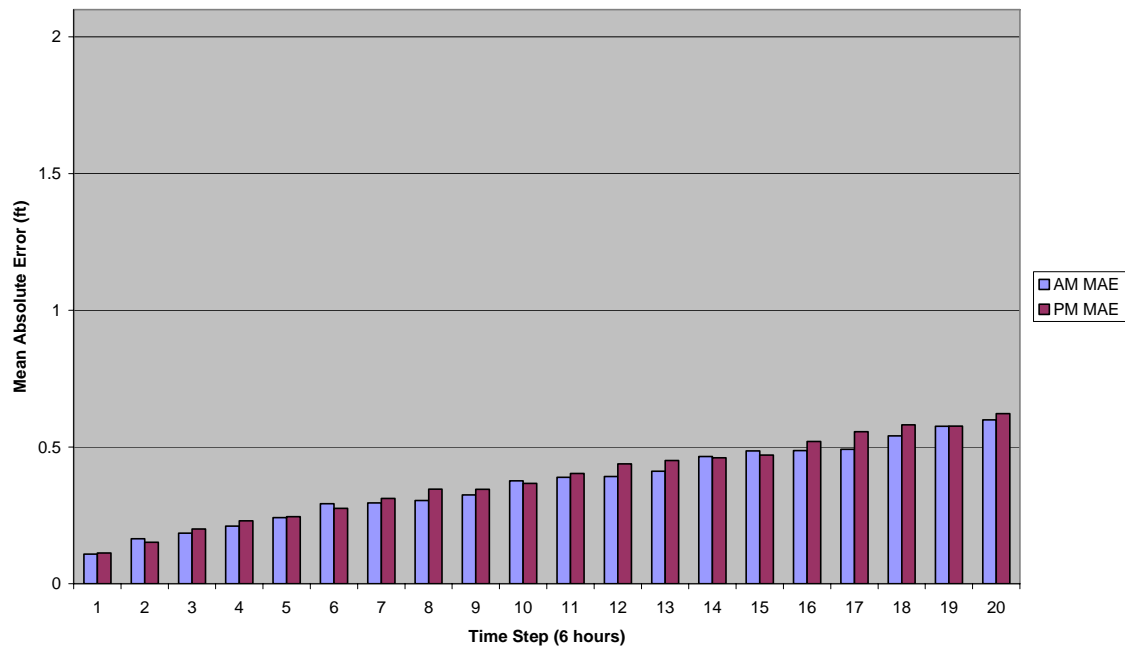
Illinois River at Beardstown
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2004



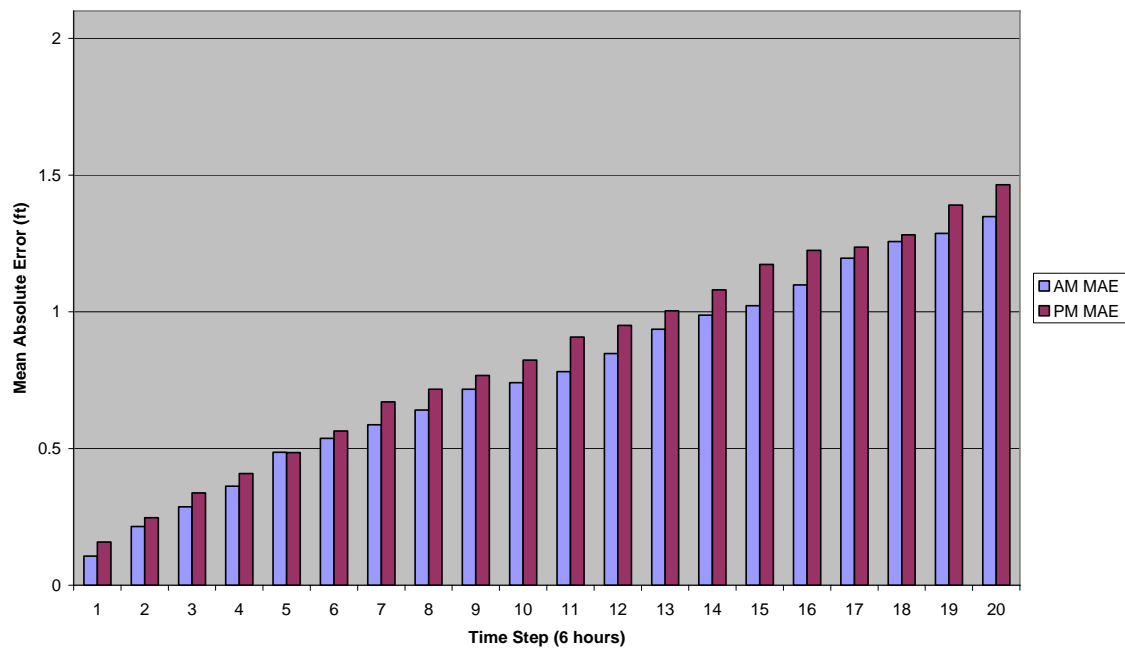
Mississippi River at Hannibal
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2004



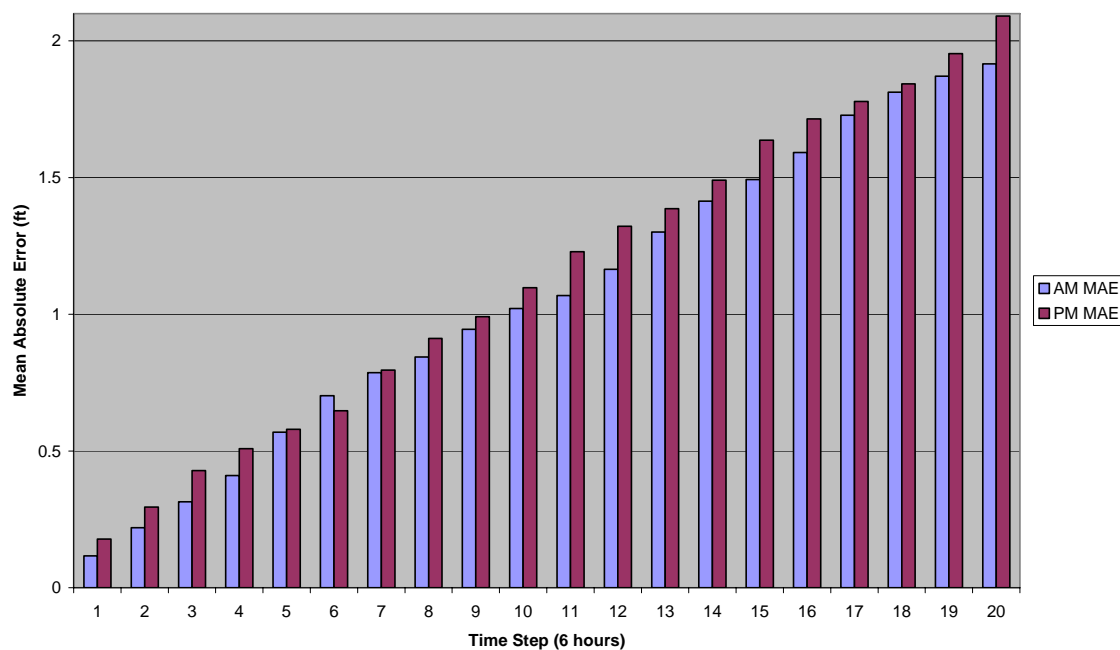
Mississippi at Rock Island
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2004



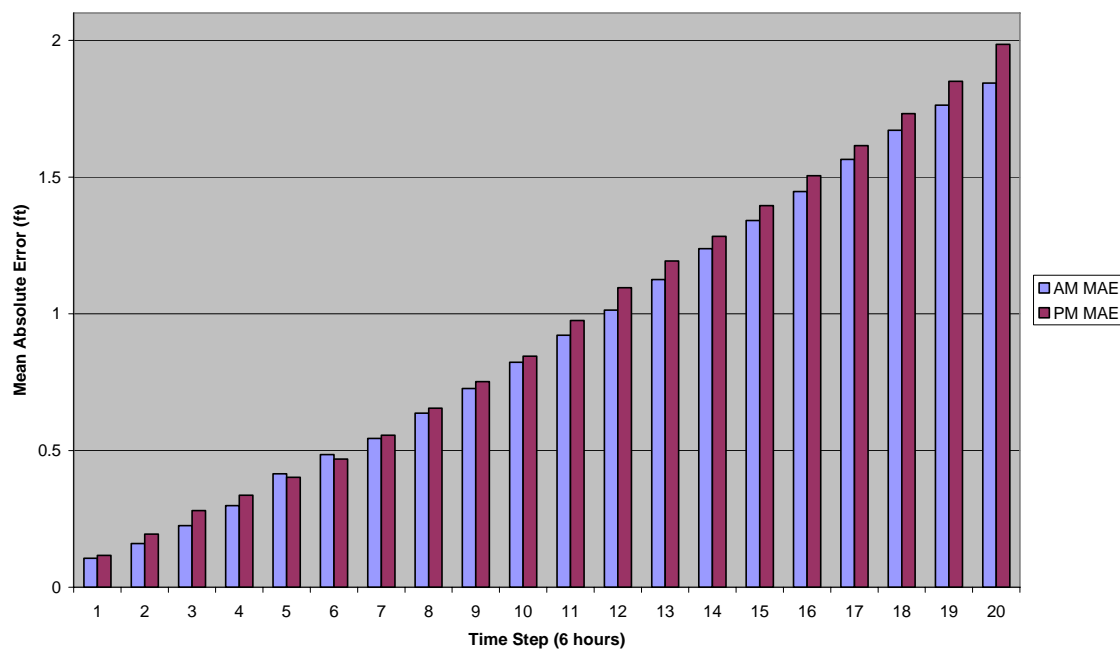
Mississippi River at Alton
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2004



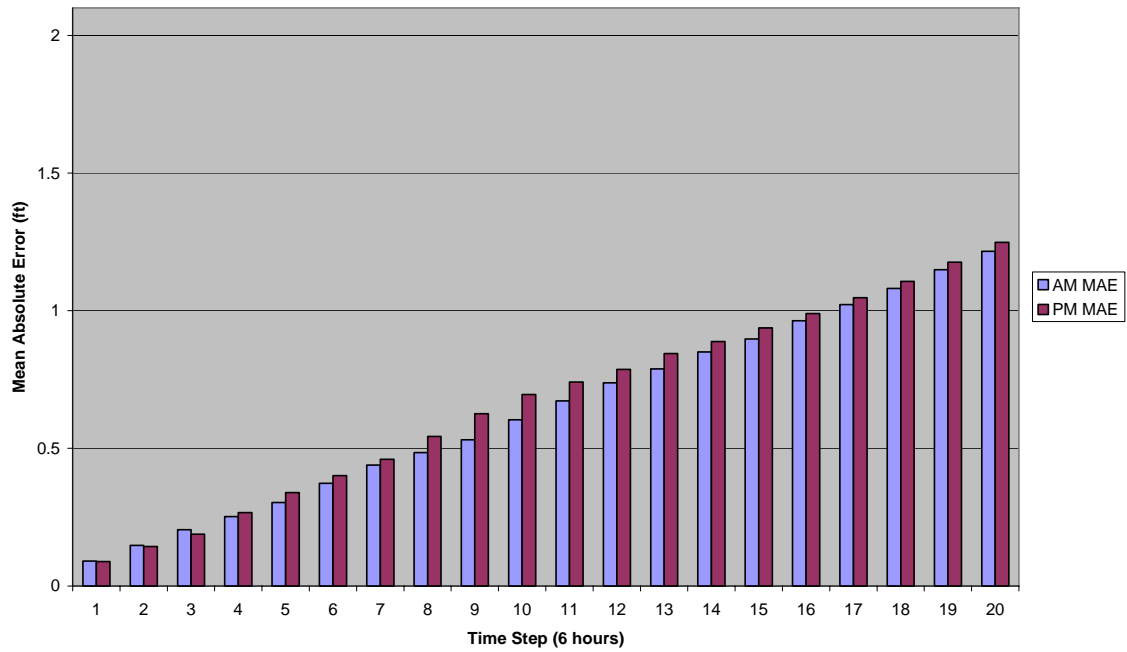
Mississippi River at St. Louis
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2004



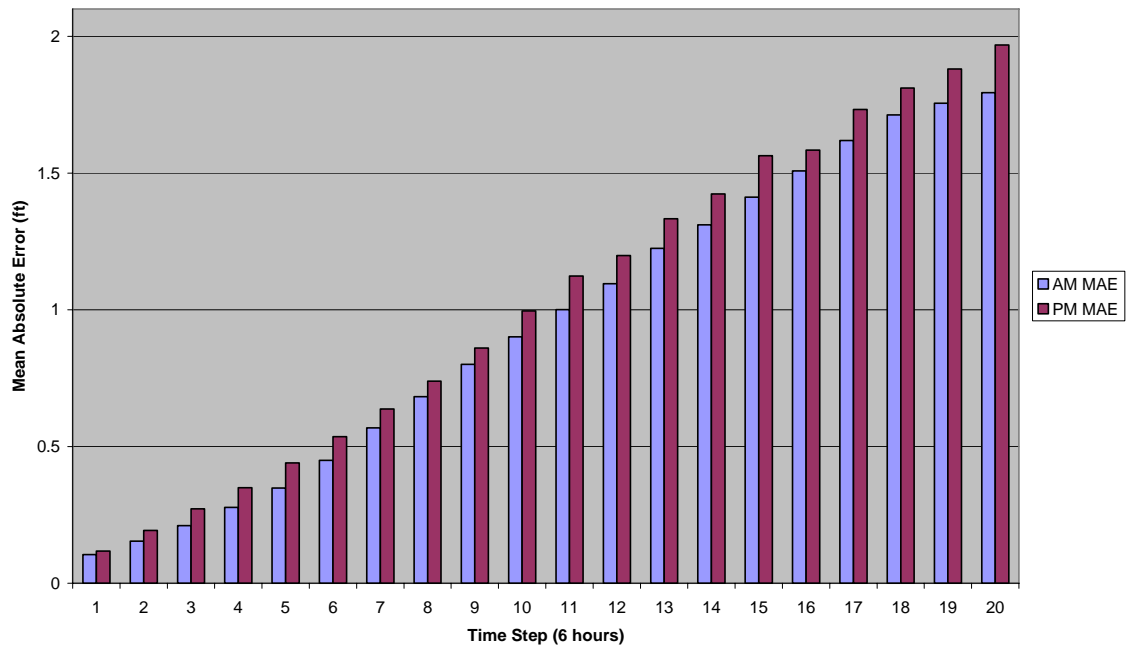
Mississippi River at Chester
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2002



Mississippi at Chester
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2003



Mississippi River at Chester
Morning vs Evening 5 Day Forecast Mean Absolute Error, Jan-May 2004



References

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